Code No: R2022024 **R20** **SET - 1**

II B. Tech II Semester Supplementary Examinations, December - 2022

INDUCTION AND SYNCHRONOUS MACHINES

(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 70**

Answer any **FIVE** Questions, each Question from each unit
All Questions carry **Equal** Marks

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UNIT-I

1 a) Deduce and discuss the equivalent circuit of a three-phase induction motor. [7M]

b) A 8 kW, 400V 3-phase, 4 pole 50 Hz slip-ring induction motor develops a rated output at rated voltage and frequency and with its slip rings short circuited. The maximum torque equal to twice the full-load torque, occurs at slip of 10% with zero external resistance in the rotor circuit. Stator resistance and rotational losses are neglected. Determine i) slip and rotor speed at full-load torque ii) rotor ohmic loss at full-load torque iii) starting torque at rated voltage and frequency. [7M]

Or

2 a) Explain the construction of cage and wound rotor induction machine. [7M]

b) A 4 pole, 50 Hz, 7.4 kW motor, at rated voltage and frequency has a starting torque of 150% and a maximum torque of 200% of full-load torque. Calculate [7M]
i) Full-load speed and ii) Speed at maximum torque

UNIT-II

3 a) Explain the various regions of torque–slip characteristics of three phase induction motor. [7M]

b) A three phase induction motor has a 4-pole, star connected stator winding. The motor runs on a 50 Hz supply with 200 V between lines. The rotor resistance and standstill rotor resistance per phase are 0.15 Ω and 0.85 Ω. The ratio of rotor to stator turns is 0.69. Calculate [7M]
i) total torque at 4% slip ii) maximum torque iii) speed at maximum torque
iv) maximum mechanical power. Neglect stator impedance.

Or

4 a) A 50 kW, 6 pole, 50 Hz, 450 V three phase slip ring induction motor furnished the following test figure: [7M]
No load test : 450 V 20 A p.f. = 0.15
Blocked rotor test: 200 V 150 A p.f.= 0.3
The rotor to stator copper losses on short circuit was 5:4. Draw the circle diagram and determine from it
i) The full load current and power factor
ii) The maximum torque and the maximum power input,
iii) Slip at full load
iv) efficiency at full load.

b) Explain the working of double cage and deep-bar cage induction motors. [7M]
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UNIT-III

5 a) A squirrel-cage induction motor has a starting current of six times the full-load current at a slip of 0.04. Calculate the line current and starting torque in pu of full load values for the following methods of starting: [7M]
i) Direct switching ii) Auto-transformer starting with motor current limited to 2.0 pu iii) Star-Delta starting.

b) What do you mean by "Forward and Backward" fields in single-phase Induction motor? Explain why in case of 1-phase Induction motor are not self-starting? Enlist the starting methods. [7M]

Or

6 a) How is the speed of a three-phase induction motor controlled by a stator voltage control? Show that the region of speed control by this method is limited by the slip at which maximum torque develops. [7M]

b) A 230V, 4-pole, 50 Hz, single-phase induction motor has an effective resistance and leakage reactance of 0.6Ω and 4.8Ω respectively. It is running at a speed of 1350 rpm, Determine: [7M]
i) frequencies of forward and backward rotor current components
ii) relative magnitudes of forward and backward fluxes.
Neglect magnetizing current and stator impedances

UNIT-IV

7 a) Explain the synchronization of three phase alternators. [7M]

b) A three phase, 16 –pole synchronous generator has a resultant air-gap flux of 0.06 Wb per pole. The flux is distributed sinusoidally over the pole. The stator has 2 slots per pole per phase and 4 conductors per slot are accommodated in two layers. The coli span is 150^0 electrical. Calculate the phase and line induced voltages when the machine runs at 375 rpm. [7M]

Or

8 a) Discuss the two reaction analyses of salient pole machines with phasor diagrams. [7M]

b) Two identical 2000 kVA alternators operate in parallel. The governor of first machine is such that frequency drops uniformly from 50 Hz on no load to 48 Hz on full load. The corresponding uniform speed drop of the second machine is 50 Hz to 47.5 Hz. [7M]
i) How will the two machines share a load of 3200 kW?
ii) What is the maximum load at unity power factor that can be delivered without overloading either machine.

UNIT-V

9 a) Explain the variation of current and power factor with excitation in synchronous motors. [7M]

b) A three phase, 400V, 50 Hz, 37.3 kW star connected synchronous motor has a full-load efficiency of 86%. The synchronous impedance of motor is (0.2+j1.6) Ω/phase. If the excitation of the motor is adjusted to give a leading of 0.9, calculate for load i) the induced emf ii) total mechanical power developed. [7M]

Or

10 a) A 1000 kVA, 11000 V, three phase star-connected synchronous motor has an armature resistance and reactance per phase of 3.5Ω and 40Ω respectively. Determine the induced e.m.f. and angle retardation of the rotor when fully loaded at i) unity power factor ii) 0.8 power factor lagging iii) 0.8 power factor leading. [7M]

b) Explain the working of synchronous condenser. [7M]